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Chemical Analysis of *Tacca leontopetaloides* Peels

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ABSTRACT

Tacca leontopetaloides tubers are known to be a staple food of inhabitants of the area under study, however, the peels have been found to be poisonous to livestock and other animals that feed on them. This study therefore, is aimed at investigating the nutrients and antinutritional factors in order to ascertain their composition in the peels. The peels were collected from Utange and Mbachegh wards in Katsina-Ala Local Government Area and Mbaatikyaa ward in Buruku Local Government Area of Benue State, Nigeria and were labeled as sample A, B and C respectively. The moisture, ash, Crude lipids, crude protein and carbohydrates analysis were determined. Anti-nutritional factors like phytate, oxalate, cyanogenic glycosides and saponins were also determined. Results of the analysis indicate the moisture content to be 18.58, 15.40 and 28.38% for samples A, B and C, respectively. Ash content of the peels was found to be 4.13, 9.60 and 5.13% for samples A, B and C, respectively. Lipids content of the samples was found to be 3.80, 2.85 and 1.10% for A, B and C, respectively. The amount of fibre in sample A, B and C was found to be 2.06, 2.07 and 1.10%, respectively while 0.21, 0.07 and 0.18% was obtained as the protein content of the peels, respectively. The result of carbohydrates was found to be 71.20, 69.35 and 62.94 for the three samples, respectively. Results of anti-nutrition indicate the levels of Cyanogenic glycoside to be high (45.00, 43.00 and 44.00 mg kg⁻¹). Saponin content of the peels was found to be 35.00, 31.50 and 34.50 mg kg⁻¹. Phytate in the sample to range between 28.50-29.50 mg kg⁻¹, while Haemogglutinin and oxalate were found to be 20.00-23.00, 16.50, 19.00 and 15.50 mg kg⁻¹ for samples A, B and C, respectively. *Tacca leontopetaloides* peels though has high content of carbohydrates, it is not suitable for consumption because of the high anti-nutritional factors.

Key words: *Tacca leontopetaloides*, proximate, cyanogenic glycoside, haemogglutinin, saponin, nutrient

INTRODUCTION

Hunger and malnutrition have serious ramification on man and animals, example is increase in dietary related diseases among children, women especially pregnant and lactating women. Considering the upsurge in population rate and unstable agricultural policies by the government, the problem of food shortage has been further compounded (Anhwange *et al.*, 2004). There may be no immediate solution to the problem of food security until concerted efforts are made in solving this problem (Zuku *et al.*, 2009). According to Aberoumand and Deokule (2009), though, measures are being taken to boost food production by conventional agriculture, there is the need to exploit the vast number of unconventional plants resources that exist in the wild. Akubugwo *et al.* (2007) reported that many of such plants have been identified but lack of data on their chemical

composition has limited the prospects for their utilization. Reports on proximate analysis of some wild fruits and seeds indicate that they could be good sources of nutrients for man and livestock (Aberoumand, 2011).

The exploration indigenous wild food plant is one of the measures that could be taken to avoid hunger and malnutrition. Studies have shown that most rural dwellers depend largely on some of these edible wild plants to meet up with shortages in nutrients like minerals, proteins, lipids and vitamins (Ujowundu *et al.*, 2008).

Despite the nutritional content of these plants, some are known to contained high levels of anti-nutritional factors which could be toxic to the body, hence acting as threat to the health and well being of an individual if taken (Yisa *et al.*, 2010). Therefore a knowledge of the nutritional status and the toxic levels of indigenous edible wild plants is imperative in order to encourage their cultivation and consumption.

Tacca leontopetaloides (L.) Kuntze is a species of flowering plant from the family *Dioscoreaceae*, it is also known as polynesian arrow root. It is naturally distributed from western Africa through Southeast Asia to northern Australia. It was intentionally brought to tropical Pacific Islands by early human migrations (Ukpabi *et al.*, 2009). *T. leontopetaloides* is a perennial herb with a tuberous rhizome, from which a single petiole, 60-90 cm long arises, bearing deeply lobed leaf blades consisting of three main segments, each further divided in a pinnate manner; the blades are about 30 cm across. The inflorescence is borne on a long stalk, also arising from the basal tuber and is terminated by a number of small green flowers surrounded by six or more bracts each about 3-4 cm long and numerous thread-like purplish inner bracts (Kunle *et al.*, 2003).

The fruit is an ovoid, smooth, yellowish berry, about 3.5 cm long, with six ribs. Two distinct types have been reported from the Pacific Islands, one producing a single large tuber, the other with a number of smaller (potato-sized) peels. The tubers were known to be a staple foodstuff in Polynesia and also were used as a source of starch. The starch made from the tubers was often used for the treatment of dysentery and for feeding infants. In Tahiti, it was used to make 'poi' ('poke' in the Cook Islands). 'Poi' is a traditional food which consists of a mixture of fruit pulp and starch, flavoured with vanilla and lemon and cooked in an oven (Ukpabi *et al.*, 2009).

Medicinally, the Hawaiian eats raw tubers for the treatment of stomach ailments. It is believed to treat diarrhoea and dysentery. A mixed of the raw tubers and red clay soaked in water is believed to stop internal haemorrhage in the stomach and colon; it is also applied to wounds to stop bleeding (Ukpabi *et al.*, 2009).

Despite the useful applications of the tubers, investigation have shown that the peels are highly poisonous that nobody uses them for anything, even animals that may accidentally eat the peels died immediately. It is in the light of the above that, this study considered it pertinent to look at the chemical composition of nutrients and the anti-nutritional factors of *Tacca leontopetaloides* peels in order to ascertain their nutritional suitability for use as livestock feeds.

MATERIALS AND METHODS

The peels, leaves and stems of *Tacca leontopetaloides* were collected from Utange and Mbachegh wards in Katsina-Ala Local Government Area and Mbaatikyaa ward in Buruku Local Government Area of Benue State in September, 2010 and were labeled as sample A, B and C, respectively. The samples were identified by Mr. Joshua Waya of the Department of Biological Science Benue State University Makurdi. The peels were washed with distilled water, peeled and dried in the sun to constant weight and then oven dried at 110°C for 2 h. The samples were ground to powdered and stored in screw capped containers for analysis.

The moisture and ash content were determined by the method described by Pearson (1976). Crude lipids was determined by soxlet extraction using petroleum ether (40-60), crude protein was determined by Kjeldahl method, while carbohydrates analysis was done by difference (AOAC, 1984; Pearson, 1976).

Determination of fiber content The content of the peels was determined using the method reported by Pearson (1976).

Determination of phytate: Ten grams of sample was measured into a beaker and 100 mL 0.2 M HCl was used to extract from the peels materials for 12 h. The 0.5 mL of extract was pipette into a boiling tube, 1 mL of ferric solution was added and the tube was covered and heated in a water bath for 30 min. The mixture was cooled in ice for 15 min; it was then allowed to adjust to a room temperature. Two milliliter of 2, 2-Bipyridine was added and the absorbance of the mixture was taken at 600 nm. Phytate concentration of the peels was the determined calculated using the formula:

$$\text{Phyate (mg kg}^{-1}\text{)} = \frac{\text{Absorbance}}{(\text{Molar, Absortivity})(\text{molar, Mass})(\text{path, Lenght})}$$

Determination of oxalate: Two grams of sample was weighed into a 250 mL volumetric flask, 190 mL of distilled water and 10 mL of 6 M HCl were added, the flask was heated at 100°C for 1 h to allow for complete digestion. The mixture was cooled and then made up to the mark, shake thoroughly and then filtered (whatman number 12.50). Duplicate portions of 125 mL of the filtrate were measured into the conical flask and four drops of methyl red indicator was added. This is follow by addition of NH₄OH solution (dropwise) until the test solution changes from semon pink colour to a faint yellow colour. Each portion was then heated to 90°C, cooled to room temperature and filtered to remove precipitate containing ferrous ion, 10 mL of 5% CaCl₂ solution was added while being stirred constantly. After heating for 30 min, it was cooled to room temperature and left overnight at 5°C. The solution was then centrifuged at 2500 rpm for 5 min. The sepernant was decanted and the precipitate dissolved in 10 mL of 20% (V/V) H₂SO₄ solution. The resulting mixture was 300 mL, aliquots of 125 mL, heated until near boiling and titrated against 0.05 M standardized KMnO₄ to a faint pink colour which persist for 30 sec. The calcium oxalate content is calculated.

Determination of cyanogenic glycosides (the acid titration method was adopted): Ten grams of sample was weighed into an 800 mL kjeldahl flask and 100 mL of water was added. The mixture was macerated at room temperature for 2 h. Hundred milliliter of distilled water and 20 mL 0.02 M AgNO₃ solution acidified with 1 mL HNO₃ were added and the mixture distilled. One hundred and fifty milliliter of distillate was collected and titrated with excess AgNO₃ after the washing the combined filtrate with 0.02 KCN using Fe alum indictor (1 mL 0.02 M AgNO₃ = 0.54 mg HCN).

Determination of hemagglutinin (spectroscopic method was adopted): Five grams of sample was weighed and dispersed in 10 mL normal saline solution buffered at pH 6.4 with a 0.01 M phosphate buffer solution. The solution was allowed to stand at room temperature for 30 min and then centrifuged to obtain the extract. Two milliliters of the extract was measured into

a test tube; 1 mL of trypsinized rabbit blood was added. A control was also measured in a test tube containing only blood cells. Both tubes were allowed to stand for 4 h at room temperature. One milliliter of normal saline was added to all the test tube and allowed to stand for 10 min after which the absorbance was taken at 620 nm.

The test tube containing only the blood cell and normal saline served as the blank. The Hemugglutinin (unit/mg) was then calculated using the formula:

$$\text{Hemugglutinin (unit/mg)} = (b-a) \times f$$

where, b is Absorbance of the test sample, a is absorbance of the blank control and f is experimental factor.

Determination of saponins: Twenty gram of each sample was dispersed in 200 mL of 20% ethanol. The suspension was heated over a hot water bath for 4 h with continuous shirring at about 55°C. The mixture was filtered and the residue re-extracted with another, 200 mL of 20% ethanol. The combined extract was reduced to 40 mL over water bath at about 90°C. The concentration was transfer into a 250 mL separatory funnel and 20 mL of diethyl ether was added and shaken vigorously. The aqueous layer was recovered and the purification process was repeated. 60 mL of n-butanol was added. The combined n-butanol were washed twice with 10 mL of 5% aqueous NaCl. The remaining solution was heated in a water bath. After evaporation, the sample was dried in the oven at 105°C to a constant weight. The saponin content was calculated in percentage.

Statistical analysis: The one-way analysis of variance (ANOVA) was used to compare the means of the variables. Through the general linear model program SAS and the Fisher multiple comparison procedures, the least significance different (LSD) at $p < 0.05$ was determined (McDonald, 2009).

RESULTS AND DISCUSSION

The result of proximate and food toxicant analysis of the samples is as presented in Table 1. The moisture content of the sample (Table 1) was found to be 18.58, 15.40 and 28.38% for samples A, B and C, respectively. A significant different ($p < 0.05$) was observed in the moisture content of the peels. The moisture content of the peels is relatively low, this indicate that the peels if process, could be stored for a long time without the development of moulds. The ash content of the peels (Table 1) was found to be 4.13, 9.60 and 5.13% for samples A,B and C, respectively. There was a

Table 1: Results of proximate analysis

Parameters	Sample		
	A	B	C
Moisture (%)	18.58±2.35 ^a	15.40±2.52 ^b	28.38±1.90 ^c
Ash (%)	4.13±0.50 ^a	9.60±1.06 ^b	5.13±0.70 ^c
Fats (%)	3.80±0.49 ^a	2.85±0.44 ^b	1.10±0.26 ^c
Fibre (%)	2.06±0.01 ^a	2.07±0.23 ^a	1.10±0.52 ^b
Protein (%)	0.214±0.22 ^a	0.07±0.04 ^b	0.18±0.13 ^b
Carbohydrate	71.20±0.44 ^a	69.35±0.12 ^b	62.94±0.18 ^c

Values are Mean±Standard error: Values with the same alphabet with in row are not significantly different

significant different ($p < 0.05$) in the ash content of the samples. The ash content of a plant material is a measure of its inorganic matter content. However due to volatilisation of some volatile inorganic elements at high temperature (525°C) the ash content is a direct measure of the total mineral content. The values compared favourable with other materials known to be good sources of minerals (Akpata and Miachi, 2001). The lipids content of the samples (Table 1) found to be 3.80, 2.85 and 1.10% for A, B and C, respectively. Statistical analysis of mean values indicate a significant different ($p < 0.05$) lipid content of the samples. The results indicate that the peels are not good sources of lipids. The amount of fibre in sample A, B and C (Table 1) was found to be 2.06, 2.07 and 01.10%, respectively. There was no significant different ($p < 0.05$) in the fibre content of sample A and B, while a significant different was observed in sample C. High fibre foods expand the inside walls of the colon, easing the passage of waste by absorbing large amount of water, resulting in softer and bulkier stool. Increase in the amount of fibre diet not only treat constipation but also lowers cholesterol level in the blood, reduces the risk of various cancers, bowel diseases, improve general health and well being. The amount of fibre observed in the peels is below the 18-32 g recommended for an average adult per day (Barker, 1996). When this limit is exceeded, the absorption of certain minerals including iron, zinc and calcium may be hindered.

The result of carbohydrates (Table 1) was found to be 71.20, 69.35 and 62.94 for the three samples, respectively. A significant different was observed in the carbohydrate content of the sample. The analysis indicates that *Tacca leontopetaloides* peels are not good sources for protein, they could serve as a cheap source of carbohydrates.

Apart from the primary function of provision of energy to the body, carbohydrates foods help in preventing *Ketosis*. *Ketosis* is a very serious condition that occurs when our diet is very low in carbohydrates, resulting in raised levels of chemicals called *Ketones* in the blood as the body turns to fat for energy. Carbohydrates also aid in consumption of other nutrients. There is no fixed Recommended Dietary Allowance (RDA) earmarked for carbohydrates, however, most nutritionists recommend a diet that comprises of at least 45 to 70% to stay healthy which should be primarily sourced from fresh fruits, vegetables, milk and milk products and whole grain cereals and its products (Rajeev, 2010).

Result of anti-nutritional content indicates the average content of phytate in the sample (Table 2) to range between 28.50-29.50 mg kg^{-1} . The phytic acid in food has the ability of binding phosphorus and converting it to phytate. Other mineral elements like calcium, zinc, manganese, iron and magnesium are converted to the phytin complexes. These are indigestible substances, hence these elements are made unavailable for absorption. The implicate of this is weakening the immune system of an individual (Biehl and Baker, 1997; Grases *et al.*, 2004). Phytic acid has a negative effect on amino acid digestibility, thereby posing problem to non-ruminant animals due

Table 2: Results of anti-nutritional factors (concentration in mg kg^{-1})

Parameters	Sample		
	A	B	C
Phytate	29.00 \pm 0.08 ^a	29.50 \pm 0.31 ^a	28.50 \pm 0.09 ^b
Oxalate	16.50 \pm 0.04 ^a	19.00 \pm 0.63 ^b	15.50 \pm 0.52 ^c
Cyanogenic glycoside	45.00 \pm 0.23 ^a	43.00 \pm 0.06 ^b	44.00 \pm 0.34 ^c
Haemagglutinin	22.00 \pm 0.22 ^a	20.00 \pm 0.02 ^b	23.00 \pm 0.51 ^c
Saponin	35.00 \pm 0.02 ^a	31.50 \pm 0.14 ^b	34.50 \pm 0.66 ^c

Values are Mean \pm SD. Values with the same alphabet with in row are not significantly different

to insufficient amount of intrinsic phytase necessary to hydrolyse the phytic acid complex (Turner *et al.*, 2002).

Oxalate content of the peels (Table 2) was found to be 16.50 mg kg⁻¹, 19.00 mg kg⁻¹ and 15.50 for samples A, B and C, respectively. When diets containing oxalate are eating, they concentrate in the kidneys, where it has the potential to crystallize, forming kidney stones. Oxalates are capable of producing mouth sores, indigestion and other digestive problems. The consumption of small quantities of oxalate could cause burning or numbing sensation in the mouth, while larger amounts have been reported to cause much more severe reactions. Also known as beerstone, it can accumulate on surfaces during the process of brewing beer (Pingle and Ramastri, 1978).

Cyanogenic glycosides content (Table 2) was found to be 45.00, 43.00 and 44.00 mg kg⁻¹ for samples A, B and C, respectively. The results indicate that the peels have high content of cyanogenic glycoside when compared to the 20.00 mg kg⁻¹ safe limit, C.

The results of hemagglutinin analysis shown its level in this substance to vary between 20.00-23.00 mg kg⁻¹ (Table 2), these values are slightly higher than the 20.00 mg kg⁻¹ reported as the threshold value. Hemagglutinin is a clot-promoting substance which causes red blood cells to clump together. These clustered blood cells due not properly absorb oxygen for distribution to the body's tissues and are unable to help in maintaining good cardiac health. Hemagglutinin is also known to be growth depressant substances.

Saponin content of the peels (Table 2) was found to be 35.00, 31.50 and 34.50 mg kg⁻¹. Saponins have been shown to help reduce the risk of cancer. They slow or even stop cancer cells from growing by reacting with the cholesterol in the membranes of cancer cells. It is considered to be antitumor and antimutagenic. It also work as antioxidants, preventing free radical cell damage and therefore lowering the risk of cancer. Saponins help in lowering cholesterol in the body. Despite their beneficial effects, Radostits *et al.* (1997), observed that saponins are known to interfere with the metabolism of vitamin E and causes gastroenteritis, manifested by diarrhoea and dysentery. Statistical Analysis of Variance (ANOVA) of antinutritional factors indicate a significant difference ($p < 0.05$) in all the parameters investigated.

CONCLUSION

The results of the study revealed that the *Tacca leontopetaloides* peels contained high levels of anti-nutritional factors which could be responsible for its poisonous nature as speculated. Therefore, the peels need to process before it could be used as a livestock feeds.

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